VI. *A Remark upon the New Opinion relating to the Forces of moving Bodies, in the caſe of the Colliſion of* Non-Elaſtic Bodies. *By Mr.* John Eames, *F. R. S.*

1. THE antient Opinion, and moſt generally entertained, is, that the Forces of Bodies in Motion are as their Quantities of Motion, *i. e.* as their Quantities of Matter multiplied by their reſpective Celerities.

2. The new Opinion is, that the Forces of Bodies in Motion are as their Quantities of Matter multiplied by the Squares of the Velocities; ſo that in equal Maſſes the moving Forces will not be as the Velocities themſelves, but as their Squares.

3. Hence it follows, that a Body moving with five Degrees of Velocity, moves with five and twenty Times more Force, than when it moves but with one Degree; whereas according to the common Opinion, it has but five times as much, *i. e.* proportional to its Velocity.

4. The lateſt Experiments brought to prove the truth of the new Opinion are made upon ſoft, or yielding Subſtances. Now theſe have been already obſerved to be a little complicated, and improper for this Purpoſe. The proper Uſe of Experiments of this kind being rather to diſcover, and ſettle the Laws, which ſuch kind of Subſtances obſerve in the Reſiſtance they make to Bodies moving in them, than the Forces themſelves, with which the Bodies move, which ought to be determined before hand by ſome ſimple Experiment, fit to determine that Matter.

5. A variety of Experiments have been made, and reaſoning uſed in *England* and *France*, to prove the Truth of the common Opinion; but they do not entirely ſatisfie all the Gentlemen on the other ſide of the Queſtion. The preſent ingenious Profeſſor of Mathematicks and Philoſophy at *Utrecht* tells us in the Preface to his *Epitome Elementorum Phyſico-Mathematicorum*, publiſh'd this Year, *Anno* 1726, *In corporum motorum viribus ſupputandis amplexus ſum ſententiam Cl.* Leibnitſii, Hugenii, Poleni, S. Graveſandii, & *antiquæ valedixi, quam hactenus foveram, & docueram: Neque me retinuerunt argumenta doctiſſimorum virorum in* Galliis & Britannia *eandem defendentium.*

Et quando experimenta à Poleno & 'S Graveſandio *deſcripta examinantur & inſpiciuntur, tam manifeſto evincunt vires corporum percutientium eſſe in ratione compoſita ex quadrata velocitatum, & ſimplici maſſarum, ut illis ſubſcribere teneamur, niſi apertiſſimis contradicere ſtudeamus.*

6. I beg leave to examine the truth of the new Opinion in the Caſe here propoſed, *viz. Vires corporum percutientium*; and I ſhall endeavour to ſhew from their own Principles, that it cannot be true in all the Caſes of Non Elaſtic Bodies.

7. 'Tis allow'd, that the common Rules of finding the Velocities of Non-Elaſtic Bodies after the Stroke are true: For thus the ingenious Mr. *S. Graveſand* tells us in Paragraph 251, of his *Supplementum Phyſicum*; *Ex hoc principio* (i. e. *multiplicando maſſam per velocitatem*) *deduxêre Philoſophi ipſas illas regulas* n. 234. *ſ.* 237. *ſ. quas nos variis modis ex principiis noſtris deduximus; mirum hîc quid contigit, error erroris fuit deſtructio, & duplex error ad veritatem conduxit; falſum de menſura virium ſecuti ſunt principium, & quod veritati etiam minimè congruum eſt, nullam vim intro premendo*

partes

partes, & harum ſuperando cohæſionem corpora amittere poſuere.

8. Now the Rule for finding the common Velocity of Non-Elaſtic Bodies moving the ſame way after the Colliſion, is, to divide the Sum of the Quantities of Motion in the two Bodies, by the Sum of the Quantity of Matter.

9. 'Tis alſo granted, *Motu duobus corporibus communi corpora hæc in ſe mutuo agere non poſſe.* In Sect. 215. *Supplement. Phyſ.*

10. *Pendet ergo ictus à velocitate reſpectiva, qua manente intenſitas impactionis eadem erit, quomodocunque celeritates abſolutæ varient.*

11. *Ab intenſitate hac pendet partium introceſſio, quæ ergo ſemper eadem erit, ſi duo corpora eadem velocitate reſpectiva in ſe mutuo incurrunt, quibuſcunque velocitatibus moveantur.*

12. Theſe Principles furniſh us with an Argument againſt the new Opinion. For if it be true, then equal Cauſes may have unequal Effects, and that in their own ſenſe of an Effect: The Proof ſhall be taken from Inſtances of the Effects of the Colliſion of Non-Elaſtic Bodies, whoſe reſpective Velocities ſhall be always equal.

13. Let *(*A*)* and *(*B*)* ſtand for two Non-Elaſtic Bodies of equal Quantities of Matter; and let *(*B*)* be at reſt, while *(*A*)* moves towards it with 8 degrees of Velocity.

1. Here the common Velocity after the Stroke will be half the Velocity of *(*A*)* before the Stroke, *i e.* 4 degrees. Conſequently the force in *(*B*)* thus communicated by the Stroke will be as its Square, or 16.

2. Let

2. Let (B) move forward with two degrees of Velocity, and (A) follow it with 10 degrees; the reſpective Velocity will be 8 as before; conſequently by Paragraph 10th of this Paper, the Strokes in both caſes are equal. The Velocity in (B) after the Stroke will be half the Sum of the Velocities before the Stroke, or 6 degrees, by Paragraph 8th.

According to the new Opinion, the Forces being as the Squares of the Velocities, the Force of (B) before the Stroke will be to its Force after the Stroke, as the Square of 2 is to the Square of 6; *i e.* as 4 is to 36. Subduct the Force in (B) before the Stroke, from the Force it has after the Stroke, and you have the Degrees of Force communicated by the Stroke: Which, if this Opinion were true, would be 32, *i. e* juſt double the Number of Degrees communicated by the ſame Force in the former Inſtance, which was but as 16. Thus equal Strokes produce unequal Effects in our ſenſe of Effects.

14. The following Table gives ſeveral other Inſtances. In the three firſt Columns you have the Velocities of the two Bodies both before, and after the Stroke; in the two next, you have the Forces in (B) both before, and after the Stroke; and in the ſixth, the Difference of thoſe Forces, or the different Degrees of Force effected by the ſame Stroke; and in the laſt Column, the Proportion of thoſe Forces, or Effects of the Cauſe or Stroke.

The Velocity in			The Forces in B.		Force communicated by the Stroke.	Proportion.
A	B	B				
8	0	4	0	16	16	1
10	2	6	4	36	32	2
14	6	10	36	100	64	4
18	10	14	100	196	96	6
22	14	18	196	324	128	8
26	18	22	324	484	160	10
Before		After	Before	After		
the Stroke.			the Stroke			

15. If it be ſaid, that I have not conſider'd the other part of the entire Effect of the Stroke, the Intropreſſion of the Parts; I reply, this will make but a ſmall Alteration in the matter; ſince the Intropreſſions in all theſe Caſes are equal, (Paragr 11.) the relative Velocities being by ſuppoſition the ſame: So that notwithſtanding upon the whole, one and the ſame, or equal Cauſes, will produce unequal Effects.